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## Cosmogenic burial dating of in cave-deposited alluvium: unravelling long-term incision rates and complex speleogenesis in multi-level cave systems

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Multi-level cave systems record the history of regional river incision in abandoned alluvium-filled phreatic passages which, mimicking fluvial terrace sequences, represent former phases of fluvial base-level stability. In this respect, cosmogenic burial dating of in cave-deposited alluvium (usually via the nuclide pair  $^{26}\text{Al}/^{10}\text{Be}$ ) represents a suitable method to quantify the pace of long-term river incision. Here, we present a dataset of fifteen  $^{26}\text{Al}/^{10}\text{Be}$  burial ages measured in fluvial pebbles washed into a multi-level cave system developed in Devonian limestone of the uplifted Ardenne massif (eastern Belgium). The large and well-documented Chawresse system is located along the lower Ourthe valley (i.e. the main Ardennian tributary of the Meuse river) and spans altogether an elevation difference exceeding 120 m.

The depleted  $^{26}\text{Al}/^{10}\text{Be}$  ratios measured in four individual caves show two main outcomes. Firstly, computed burial ages ranging from ~0.2 to 3.3 Ma allows highlighting an acceleration by almost one order of magnitude of the incision rates during the first half of the Middle Pleistocene (from ~25 to ~160 m/Ma). Secondly, according to the relative elevation above the present-day floodplain of the sampled material in the Manants cave (<35 m), the four internally-consistent Early Pleistocene burial ages highlight an “anomalous” old speleogenesis in the framework of a gradual base-level lowering. They instead point to intra-karsting reworking of the sampled material in the topographically complex Manants cave. This in turn suggests an independent, long-lasting speleogenetic evolution of this specific cave, which differs from the *per descensum* model of speleogenesis generally acknowledged for the regional multi-level cave systems and their abandoned phreatic galleries. In addition to its classical use for inferring long-term incision rates, cosmogenic burial dating can thus contribute to better understand specific and complex speleogenetic evolution.